



Digitized by the Internet Archive
in 2013

<http://archive.org/details/concentrationsof00dero>

BOSTON UNIVERSITY

GRADUATE SCHOOL

Dissertation

CONCENTRATIONS OF POTASSIUM IN THE SERUM

OF SELECTED PATIENTS WITH HAY FEVER

by

Matthew Arnold Derow

(B.S., College of the City of New York, 1929;
A.M., Columbia University, 1930;
M.D., Boston University School of Medicine, 1934)

submitted in partial fulfilment of the

requirements for the degree of

Doctor of Philosophy

1941

PhD
1941
de
copy 1

APPROVED

by

First Reader.....

Burkham J. Walker

Professor of Biochemistry.

Second Reader.....

Sanford B. Hooker

Professor of Immunology.

OUTLINE

REVIEW of LITERATURE

Rôle of potassium in shock.	1
Potassium in allergies.	4
Function of potassium in metabolism	5
Use of potassium salts in treatment of allergies.	7

CHOICE of PATIENTS	10
------------------------------	----

ANALYTICAL METHODS

Spectrographic methods.	11
Amperometric methods.	12
Cobaltinitrite methods.	13
Chloroplatinate methods	16
Methods using organic precipitants.	18

METHOD EMPLOYED for ANALYSIS of SERUM.	19
--	----

EXPERIMENTAL RESULTS	23
--------------------------------	----

DISCUSSION	28
----------------------	----

SUMMARY.	32
------------------	----

BIBLIOGRAPHY	33
------------------------	----

ABSTRACT of DISSERTATION	42
------------------------------------	----

AUTOBIOGRAPHY of CANDIDATE	45
--------------------------------------	----

PHOTOGRAPH of CANDIDATE.	46
----------------------------------	----

TABLES and FIGURES

TABLE I, summary of histories, cutaneous reactions, and treatment of individual patients, and results of potassium analyses in each case.	24
TABLE II, distribution of potassium values for entire series, and for various subgroups, with statistical data for each.	25
TABLE III, summary of series of normal controls.	27
FIGURE I, graphic representation of potassium values in entire series, and in subgroups	26
FIGURE II, graphic representation of results of normal series.	27

REVIEW of LITERATURE

It is known that shock and shock-like conditions, produced by a variety of means, result in an increase in the potassium content of the blood plasma. This change has been observed in experimental animals and in human beings.

Kerr in 1926 (59) reported an increase in plasma potassium following hemorrhage. This finding was subsequently confirmed by other workers (109, 117, 127, 128) who consistently found increases often as high as one hundred per cent. Moglia (75) showed that a marked drop in blood pressure, produced by whatever cause, (hemorrhage, nerve section, drugs) gave rise to this increase in plasma potassium. The increase of extracellular potassium has been shown to be caused by a diffusion of potassium out of tissue cells, which was especially marked in the case of injury to the cells. (109, 90, 128) Rises in plasma potassium following traumatic and hyperpyrexial shock have been reported by Bisgard et al.

(6)

Zwemer and his coworkers, in studies of shock caused by trauma, hemorrhage, manipulation of viscera, (127, 128) and by the injection of potassium salts, (117) noted the similarity of their results to those seen after the injection of histamine (68) and in cases of cortico-adrenal insufficiency. (129) Moreover they point out that this increase in potassium can set up a vicious cycle, inasmuch as increased potassium content in body fluids is injurious to cells (122) and injured cells liberate potassium. (128) On the basis of these findings and a presumed breakdown of the cortico-adrenal mechanism for potassium regulation they proposed a therapeutic regime for shock based essentially on the administra-

tion of sodium chloride solutions and cortical extract. (96, 128)

Studies on anaphylactic shock show essentially the same changes in the plasma-potassium levels as are seen in the work just described. Schittenhelm, Erhardt and Warnat (90) determined the potassium levels in rabbits and dogs during the process of sensitization and after the production of anaphylactic shock. In both species there was a slight but definite increase in the potassium levels during the sensitized state, and a marked increase during anaphylactic shock, the increases paralleling the acuteness and severity of the shock reaction. Samples of blood from the portal vein showed the greatest increases in plasma-potassium content, and plasma from other sources such as the hepatic vein, jugular vein, and carotid artery demonstrated concomitant though not so marked rises in potassium content. This finding is rather interesting when we note that Zwemer et al (127, 128) found that shock is more easily induced by visceral manipulation than by trauma to the extremities.

Comparisons of the potassium content of the plasma and the erythrocytes before and after shock indicated that although some of the increase of potassium in the plasma may have been of erythrocytic origin, the entire rise could by no means be explained on this basis. The marked drop in potassium content of the lungs and other tissues seems to indicate that most of the increase in plasma potassium could be attributed to diffusion from extravascular tissue cells. The high values of potassium in plasma from the portal vein as compared to that from the hepatic vein, and the relatively low loss of potassium by the liver is consistent with the existence in this organ of a stabilizing mechanism that acts by withdrawing potassium from the blood when its level tends to increase. That

this is probably so is best shown in the cases of prolonged, nonfatal shock where the difference between the levels of potassium in the portal and hepatic veins averaged about twelve milligrams per hundred milliliters of plasma.

Studies of the calcium content of the blood of these animals showed that the shock condition was associated with an increase of the potassium:calcium ratio from a normal value of about 2.3 to values as high as 5.9 and are confirmed by later work by Vallogini. (118) The compensating power of the liver is seen in the animals with subacute shock where the ratios in portal and hepatic venous plasma were 5.6 and 4.3 respectively, and that in the carotid artery was 2.9. Part of this compensation was produced by absorption of potassium by the liver and part by a liberation of calcium by the liver and lungs, as shown by analyses of these organs for potassium and calcium. It would seem, thus, that the deleterious effects of the increase in potassium are at least in part due to the disturbance of the potassium:calcium ratio as well as to the absolute rise in the potassium level.

Work by Wenner and Buhrmester (124) on rabbits sensitized to egg-albumin obtained essentially the same results as those just described. The sensitized animals showed a moderate increase in plasma potassium, and animals in shock a marked increase. Analysis of the blood for acetylcholine demonstrated appreciable amounts during anaphylactic shock, whereas it was absent from the normal bloods. These workers claim that the increases in potassium and acetylcholine probably exert a greater effect on the production of shock than does the increase in histamine. Whether these are independent changes both caused by the anaphylactic injury to

the cells, or are related as cause and effect is hard to say inasmuch as Feldberg and Guimaraes (39) demonstrated the liberation of acetylcholine by injections of potassium chloride, and Cicardo and Moglia (18) showed a liberation of potassium by the administration of acetylcholine.

Inasmuch as the basic mechanism of allergic diseases is the same as that of anaphylactic shock, i.e., an antigen reacting with a sensitized body cell, one would expect that the serum- or plasma-potassium levels during allergic manifestations such as asthma, eczema, and vasomotor disturbances would resemble those of experimental anaphylaxis. There have been not many extensive studies reported on human cases, but the work that has been published seems to bear this out.

Hoffman and Jacobs (51) reported a series of seven patients with asthma, all of whom showed definite increases in serum-potassium content, averaging 24.2 mg per 100 ml as compared with 19.3 mg per 100 ml for a series of normal controls, and Vallogini (118) obtained essentially similar results. Rusk et al (88) found an average level of 24.4 mg per 100 ml for a series of seven patients during acute attacks of asthma and a somewhat lower value (23.6 mg per 100 ml) for ten symptom-free asthmatics. Stoesser and Cook in an extensive study on children reported a rise in potassium levels during the presence of symptoms, and a fall to normal levels as the symptoms abated and the clinical condition of the patients improved. (101, 102) These workers also pointed out that the occurrence of clinical symptoms seemed to depend on the state of the sodium, potassium, and water balances in the body. Thus, on a low sodium intake under conditions favoring water retention the asthmatic symptoms tended to abate and finally disappear. During this phase the blood-potassium values fell. When the sodium intake was increased, asthmatic attacks

would recur. Rapport, (83) in some unpublished work, found that the daily variations in serum-potassium of asthmatics were large, but found no consistent changes during induced asthmatic attacks. Parker (80) in reporting a small series of asthmatic patients found a very slight increase over normal values.

Two reports on cutaneous allergies (eczema) indicate a slight decrease in the serum-potassium concentrations during the presence of symptoms, with a return to normal on remission of the symptoms. (78, 80)

Just what rôle potassium plays in the metabolism of the cells has been the subject of numerous investigations. It is known that in human beings and in many animals, though not in all, the chief deposits of potassium are within the cells and it is present in but small amounts in the extracellular fluids, where sodium predominates. (38, 67, 77, 90) There has been considerable speculation on the mechanism by which the marked concentration gradient that exists between the cell and its surrounding fluids is maintained, and also whether or not potassium ions can pass through the normal cell membrane. Conway and Boyle (22), from theoretical considerations, have shown how a membrane freely permeable to potassium ions could still result in a high concentration within the cell by operation of the Donnan equilibrium. Tarusov and Burlakova (106) claim that potassium is bound within the cell in an unionized state by the cell proteins. Apart from teleological arguments as to interchange across the cell membrane, work with radioactive potassium used as a tracer seems to show that potassium does diffuse through the membranes of normal cells. (43) Brock et al (13, 31) have shown that during cell activity due to stimulation intracellular potassium serves to neutralize

fixed acid metabolic products and is thereby lost from the cell by the diffusion outward of the resulting salts. This same process occurs after injury of the cell but at a morerapid rate. Further stimulation is ineffective after the store of intracellular potassium is depleted, and recovery will not take place unless there are free potassium ions in the surrounding medium, whence it migrates back into the cell. During normal metabolism there is no loss of cell potassium inasmuch as the chief acids formed are volatile and can diffuse out of the cell without a concomitant loss of potassium. This finding is confirmed by Brewer (11) who showed that under increased metabolic activity there is an increase in plasma-potassium with a corresponding depletion within the cell.

It has been seen that there is a loss of potassium from the cells under the influence of histamine and acetylcholine in the production of shock. However the plasma-potassium level is also raised under the influence of epinephrine, despite the fact that this substance acts as a physiological antagonist to histamine and acetylcholine and is of inestimable value in combatting shock. (32, 26, 61, 73, 76, 93) This increase of serum potassium following epinephrine apparently is of hepatic origin, as shown by studies on blood taken from the portal and hepatic veins respectively. (32) Furthermore, there seems to be a great similarity between the observed effects of small doses of potassium salts and of epinephrine, so much so, that Camp and Higgins (17) claim that all the effects attributed to epinephrine are probably caused by potassium. However, there may be definite species differences in this action, for Keys (61) who confirms the previous work on animals, reports a definite lowering of the plasma potassium following the administration of epi-

nephrine to human subjects. This immediate fall in concentration is followed after about one hour by a slight but definite rise.

Talbott and Schwab (105) in reviewing the evidence in regard to potassium sum up its functions in the body in three rôles:

- 1/ As principle base in tissues and blood cells;
- 2/ As insulin antagonist and epinephrine-like substance;
- 3/ As antagonist of cholinesterase and principle base in muscle cells.

They also point out that potassium tends to replace sodium in body fluids and cause sodium excretion. (9) It is on the basis of this action that potassium salts have been used as diuretics in the treatment of edema.

On the basis of the relation of potassium to epinephrine and histamine reactions, and the efficacy of potassium salts in the treatment of Ménière's syndrome, where attacks are associated with increases in plasma-potassium levels (104), Rusk and Kenamore (87) suggested the use of potassium salts in the treatment of urticaria where similar plasma changes are found. Their "New Therapeutic Approach" consisted in the use of a high protein, low sodium, acid-ash diet, with the addition of potassium chloride. The same diet had been previously suggested by Beckman (5) as being of possible benefit in allergic states on the ground that "potential alkalosis" was the basic causative agent in allergic disorders. To combat this alkalotic state Beckman prescribed dilute hydrochloric acid, ammonium chloride, or sodium acid phosphate in addition to the dietary regime. In his preliminary communication Rusk reported very favorable results in six cases of chronic urticaria. A later more complete study confirmed this first report in regard to urticaria and also indicated favorable though not as clean cut results in several cases of asthma. (88)

Hay Fever Bloom applied this "New Approach" to the treatment of hay fever and reported excellent results in twenty-nine patients with hay fever and other allergic manifestations such as urticaria, eczema, polyposis, and migraine, but very poor results in asthma. (7) A later report by Bloom (8) confirmed the findings of the preliminary note. Following these two favorable reports a series of confirmations and refutations of these original results appeared in the literature. Abt (1) and Smith and Steffenson (99) reported excellent results with potassium therapy in hay fever, and Parker (80) reported fair improvement. However, all of the first author's cases were treated after October twentieth and the relief from symptoms may very well have been due to the disappearance of the offending pollen from the air. Stoesser and Cook in a series of studies on asthma in children reported improvement on a regime of low sodium intake and the use of pitressin to promote water retention. (23, 101, 102) Inasmuch as their methods were not strictly comparable to those of Bloom or of Rusk one cannot consider their results as direct confirmation.

On the other hand several extensive, and well controlled trials of the potassium regime applied to hay fever, asthma, urticaria, and eczema uniformly fail to find any beneficial results. (20, 37, 44, 42, 46, 86) The consensus of these workers may be given in a quotation from Engelsher's report: "---potassium chloride is of questionable value in hay fever and other allergies---";(37)

In view of the marked disagreement as to the value of potassium therapy in hay fever in particular, and as there were no reports in the literature as to the changes, if any, in serum-potassium levels in

hay fever, this study was started in 1939. Since the inception of this series of determinations two reports of blood-potassium levels in hay fever have been published. Harsh and Donavan in a series of fifteen cases found "no significant alteration in the concentration of either ion (sodium and potassium) ---". (46) Parker (80) found no significant change in the average potassium level of thirty-eight allergic sera from that of a series of twenty-eight normal individuals. However he indicated that the hay fever and asthma sufferers tended to show a slightly higher level than other allergic cases. Although his detailed data were not given, the range of values in the series of allergic cases is patently broader than that of the normal series.

CHOICE OF PATIENTS

The subjects studied are for the great majority patients at the Allergy Clinic of the Massachusetts Memorial Hospitals. To have comparable conditions, as far as possible, in the individual cases of the series the study was limited to uncomplicated (as far as symptoms and history indicated) cases of ragweed hay fever.

Serum-potassium levels were determined on all patients of the series after onset of symptoms, and in as many as possible before the advent of the ragweed-pollinating season. In every case blood samples were taken before any treatment was administered, to obviate any possibility of a change in serum-potassium value because of a reaction to the injection of the pollen extract.

ANALYTICAL METHODS

Micro methods for the determination of potassium depend essentially on five basic procedures:

- 1- Spectrographic analysis of the crude or previously prepared material;
- 2- Amperometric analysis of suitable solutions of the potassium ion;
- 3- Precipitation of potassium by some form of cobaltinitrite reagent;
- 4- Precipitation of potassium by chloroplatinic acid;
- 5- Precipitation of potassium by special organic reagents.

Methods based on each of these basic procedures, with the possible exception of the second, have been proposed for use with biological materials. The literature on the subject is teeming with modifications and variations that have been suggested by various authors for special purposes or as improvements, either in precision or simplicity of manipulation, in the estimation of the potassium content of blood. An exhaustive critique of available micro methods for the determination of potassium is outside the province of this study. However, a review of some of the more popular procedures may serve to explain the choice of the analytical technic used in the present series of determinations.

Spectrographic methods: Spectrographic analysis is so extremely sensitive, and requires such exceedingly small samples of material for a determination, that it cannot be approached in this respect by any of the chemical procedures for the detection of minute quantities of potassium. The fact that the amount of material required for quantitative work is limited practically by the difficulty of measuring out very small volumes (33) is an obvious advantage where the quantity of material available for analysis is limited. An additional advantage lies in the fact

that, when necessary, determinations can be made without preliminary treatment of the sample to be analysed. (79) However, most methods for use with biological materials use a solution of the ashed sample for the final determination. (33, 112) By virtue of the minimal amount of preliminary preparation required, and the ease and rapidity of the actual spectrographic procedure, such methods have found wide application in fields, such as agriculture, where the speed factor outweighs the precisional advantages of the slower chemical methods in mass investigations. (60, 79, 91) However, the range of error, up to ten per cent, of the methods as yet available for materials such as urine and blood militates against their use in clinical investigations where a ten per cent increase or decrease in the potassium level would be of possible pathological significance.

Amperometric methods: The rapidity, ease of manipulation, and precision of amperometric methods of analysis make their application to the estimation of potassium in biological materials highly desirable. In spite of the great interest in polarometry, as evidenced by the many publications in the field and the number of ingenious and more or less simple apparatus offered by instrument manufacturers, there is as yet no satisfactory method available for the determination of potassium by this potentially excellent technic. Methods for the determination of total base have been devised and are in general satisfactory. However, the proximity of the half-wave potentials of the sodium and potassium ions, together with the relative amounts of these ions in biological materials has made difficult the precise estimation of potassium content by the amperometric technic. There is no reason to believe that these dif-

difficulties are insurmountable, and a satisfactory solution of the problem should be forthcoming ere very long.

Precipitation of potassium by cobaltinitrite reagents: These methods are based on the relative insolubility of potassium cobaltinitrite salts (49) and constitute by far the majority of the procedures described in the literature. The precipitants most commonly used are sodium cobaltinitrite and sodium silver cobaltinitrite, the latter being used either as a mixture or by the successive addition of silver nitrate and sodium cobaltinitrite to the substrate. The use of the sodium silver cobaltinitrite reagent is based on the lower solubility and presumably more constant composition of the potassium silver cobaltinitrite complex. (25) Methods vary as to whether the precipitation is carried out directly in the serum or plasma, (3, 28, 35, 50, 53, 54, 64, 66, 69, 100) in a protein-free filtrate, (4, 10, 12, 35, 66, 71, 72, 85, 107, 116, 115, 123) or following a wet or dry ashing of the materials to be analyzed. (14, 19, 63, 125, 126) The final estimation of potassium depends on the quantitative determination of one of the components of the precipitate by titrimetric, colorimetric, or more recently, by photometric technics.

The estimation of the nitrite portion of the precipitate forms the basis of the majority of commonly used methods. Clausen (19) decomposed the precipitate by heating in alkali and titrated the nitrite directly with permanganate. The method of Kramer and Tisdall (63, 65, 66, 113), one of the most widely used and the parent of perhaps the greatest number of subsequent modifications oxidizes the nitrite with an excess of permanganate, the latter being reduced by an excess of oxalate which in turn is finally titrated with permanganate. The chief modifications of

this method have been essentially in manipulative detail (3, 4, 52, 53) and in the choice of the oxidation-reduction system used for the estimation of the nitrite portion of the precipitate. One method utilizes the original permanganate oxidation of the precipitate but determines the excess permanganate by the subsequent treatment with potassium iodide and titration of the liberated iodine with sodium thiosulphate. (28) Ceric salts have been used to oxidize the nitrite, with a subsequent titration of the excess cerium iodimetrically. (15, 58) Kramer and Gittleman modified the original procedure of Kramer and Tisdall by the gasometric determination of the nitrite fraction (64), and this technic of estimation is also used by Weichselbaum et al. (123) The colorimetric determination of the nitrite fraction, utilizing the diazotization of sulphanilic acid and coupling with α -naphthylamine to develop a colored product was developed by Doisy and Bell and first described by Briggs. (12) This method was later modified by Taylor (107) and by Truszkowski and Zwemer who also develop the colored compound by the addition of Griess' reagent. (116)

The use of the cobalt portion of the precipitate for quantitation is seen in the method of ^aTakahashi (103) who developed a colored compound of cobalt with ammonium sulphide and in Lebermann's use of concentrated hydrochloric acid to give a green-blue solution of the precipitate. (69) Yoshimatsu (125) and later Yoshimatsu and Uga (126) decomposed the precipitate with concentrated nitric acid and developed a colored cobalt complex with dimethylglyoxime and sodium sulphide. Breh and Gaebler (10) and Durupt and Schlesinger (35) estimated the potassium from the cobalt content of the precipitate by the development of a color with ammonium thiocyanate and colorimetric comparison with similarly treated potassium standards. Robinson and Putnam (85) modified this method for use with

smaller amounts of material, and Marenzi and Gerschmann (71) used the same reaction, claiming better accuracy because of finer control of the conditions of precipitation, later adapting the method for photometric analysis. (72) Sobel and Kramer (100) used cysteine hydrochloride and hydrogen peroxide to yield a yellow colored compound of the cobalt portion of the precipitate for comparison against standard cobalt solutions, basing the procedure on the earlier methods of Michaelis and Yamaguchi (74) and of Schubert (92). Jacobs and Hoffman estimated the potassium colorimetrically from the color formed by cobalt with a choline-ferrocyanide reagent (54), and Hoffman later modified the same method for use with the photoelectric colorimeter. (50)

The use of the potassium portion of the precipitate for the final estimation is represented by the method of Fiske and Litarczek in which the original potassium silver cobaltinitrite precipitate is ashed, the potassium reprecipitated as potassium acid tartrate and determined by titration with alkali. (40) Cumings decomposed the potassium silver cobaltinitrite precipitate with nitric acid and titrated the silver by the Volhard method. (25, 114, 119)

The popularity of the cobaltinitrite methods is perhaps based on the fact that it is the most sensitive qualitative chemical test for the potassium ion, detecting as little as one part of the element in one hundred thousand parts of diluent. (57) Also it furnishes relatively simple means of final estimation by the analysis of the potassium precipitate. The use of the stable cobalt or silver fractions of the complex tends to circumvent errors associated with the estimation of the relatively unstable nitrite fraction. However, all of these methods share the disability that the precipitated potassium complex is not of definite com-

position. (57, 58, 81, 98) Many of the numerous variations of the cobaltinitrite procedure have been devised in order to fix the conditions of precipitation so as to yield a precipitate of more nearly constant composition. This is especially true in those methods that precipitate the potassium directly from serum or plasma (28, 53, 65), and to some extent in those that utilize a protein-free filtrate. While it is probably possible to achieve this goal in very carefully supervised analyses under the best of conditions, in the majority of clinical determinations it is to be feared that such ideal conditions do not obtain and that consequently the precision of the results must suffer. (98)

Precipitation of potassium by chloroplatinic acid: The chloroplatinate methods for the determination of potassium are based on the insolubility of potassium chloroplatinate in alcoholic solutions. (49, 114) The only interfering substance is the ammonium ion which also forms a salt of low solubility (49), and hence must be eliminated, if present, before the precipitation is carried out. This interference of the ammonium ion is not peculiar to the chloroplatinate method, but is also a factor in the cobaltinitrite methods where the presence of ammonia must be similarly guarded against. Potassium chloroplatinate is of constant composition, K_2PtCl_6 , (114) and most variations of this method have been devised in order to minimize the errors inherent in ashing the original sample and in washing and transferring the chloroplatinate precipitate. Both titrimetric and colorimetric technics are in use.

The basic micro method is that of Shohl and Bennett (98), which is an adaptation of the Lindo-Gladding macro procedure (2) for use with small amounts of material. The precipitation is carried out on the ash

of a trichloroacetic acid filtrate of serum or plasma. Whole blood also may be used after suitable dilution. The precipitate is washed free from excess chloroplatinic acid, dissolved in water, and converted to potassium iodoplatinate by the addition of potassium iodide. The resulting red solution may be titrated with standard thiosulphate (82), compared colorimetrically with suitable standards (16), or estimated photometrically.

(48)

Hartzler (47) refined the technic for still smaller amounts of material and expedited the titration by the use of the Rehberg microburette. (84) The modification of Consolazio and Talbott (21) which is used in this series and will be described in greater detail below, modifies the method further by eliminating all filtrations and transfers, and carries out the entire determination in a single container. The determination is titrimetric, using the Rehberg microburette as suggested by Hartzler.

The two most recent modifications of the Shohl and Bennett technic are Tenery and Anderson's (108), adapted for use with 0.3 ml of plasma and quantitating the iodoplatinate solution photoelectrically; and Salit's (89) using a dry ashing procedure and colorimetric comparison of the iodoplatinate solution.

The volumetric method of Harrison and Darrow (45) throws down the potassium as the chloroplatinate but differs from the above described methods in the treatment of the precipitate. The potassium chloroplatinate is reduced to the chloroplatinite by means of sodium bisulphite, liberating chloride which is then titrated by an adaptation of the Volhard method. (119, 114) Bullock and Kirk (14) also estimate potassium

from the chloride portion of the precipitate, by reducing the platinum to the metallic state with metallic magnesium and titrating the liberated chloride directly with silver nitrate, using dichlorofluorescein as an adsorption-indicator.

The maximal variation of the chloroplatinate methods described is claimed to be between plus and minus one to two per cent as judged by determinations on solutions of known potassium-content.

Precipitation of potassium by special organic reagents: The use of hexanitrodiphenylamine (dipicrylamine) as a precipitant in the determination of potassium has been suggested by Shemtsis (97) and by Kolthoff and Bendix. (62) In the former method the precipitate is converted to the titanium compound of dipicrylamine and the excess titanium titrated with ferric ammonium sulphate, using ammonium thiocyanate or leuco methyl7 ene blue as indicators. In the latter the precipitate is decomposed by hydrochloric acid and the excess acid titrated with standard alkali. At present the optimal amount for the method seems to be about ten milligrams of potassium although one milligram can be estimated within one or two per cent error. Care must be taken to remove several interfering metals, of which iron is the most likely to occur in biological materials.

Although this reagent furnishes a new means for the precipitation of potassium, its accuracy in the range encountered in biological materials is not yet definitely established, and does not justify the more involved procedure required, especially by comparison with some of the chloroplatinate methods.

METHOD EMPLOYED for ANALYSIS of SERUM

The samples of serum were analyzed by the method of Consolazio and Talbott (21), except for the final titration. Lacking a Rehberg microburette, the iodoplatinate solution was titrated with 0.01 N $\text{Na}_2\text{S}_2\text{O}_3$ using a semimicroburette of 5 ml total volume, graduated in 0.01 ml and permitting estimation to 0.001 ml. The thiosulphate solution was standardized with standard potassium iodate solution before and after the titration of each group of sera, the average of the two groups of titrations being used in calculating the potassium values for the samples. To insure the accuracy of the standardization, two independent potassium iodate standards were used in evaluating the thiosulphate, and these were in turn checked from time to time against a standard copper solution. At no time did the individual titrations of the thiosulphate solution differ by more than 0.2 per cent from the mean of the series of determinations. Blank determinations on the materials used in the analysis showed negligible correction factors for the potassium content of the reagents in the amounts used for the determinations, and the same lot of chemicals was used for the entire series of analyses. Toward the end of the series, when a Rehberg microburette was obtained, check determinations, titrated with the microburette using 0.1 N thiosulphate and by the method described above showed no significant differences between the results obtained by the two methods of titration; which tended to justify the slight modification of the method employed. The Rehberg burette was used for the remaining samples, more for expediency than because of any inherently superior precisional qualities.

All sera were analyzed in duplicate, and many in triplicate or

quadruplicate, when the amounts obtained were sufficient for the additional determinations. The sera were separated from their clots by spinning with a minimum of manipulation, as soon after collection of the blood as was practicable. The longest time of contact between the serum and clot in any of this series was about four hours. These precautions are necessary inasmuch as diffusion of the potassium ions from the red cells into the serum is favored by prolonged contact and agitation (27, 29, 30, 34, 55, 56, 65, 94, 95, 110, 120, 121), but is little affected by centrifugation. (24) All samples were checked spectroscopically for evidence of hemolysis to guard against this source of apparent increases in the serum potassium. (38, 67, 77, 94, 95, 100) In this connection it is interesting to note that many sera showing definite bands of hemoglobin spectroscopically were well within a low normal range of potassium-content. One may infer from this that the potassium increases caused by hemolysis of red cells sufficient to give detectable traces of hemoglobin in the serum were not such as to alter appreciably the potassium values obtained by the analytical method employed. Per contra, the absence of hemoglobin in the serum cannot be used as a criterion for gauging the amount of potassium of erythrocytic origin inasmuch as the basic level of serum-potassium can be increased severalfold by diffusion from the red cells in the absence of more than minute traces of hemoglobin. (29, 95) After separation of the sera they were refrigerated, with precautions against evaporation, until analyzed.

The following is a detailed description of the analytical procedure:

Reagents:

Platinum chloride, 20 per cent solution in N HCl.

Absolute ethyl alcohol, saturated with K_2PtCl_6 .

Sulfuric acid, 50 per cent by volume.

Potassium iodide, iodate free, 2N (33 per cent solution), freshly prepared.

Special apparatus:

Cone-pointed quartz tube, 10 ml capacity.*

Rehberg microburette, 0.225 ml capacity.**

Glass stirring rods, 1.0 mm diameter.

Duplicate 1 ml samples of serum were measured into quartz centrifuge tubes of 10 ml capacity.* 2 drops of 50 per cent H_2SO_4 were added to each tube and the contents well mixed. The tubes were then placed in an electrically heated oven, at room temperature, the temperature raised gradually to 110-120° C and maintained there until the sera were dry and charred (usually about 5 to 6 hours); They were then transferred to an electric muffle furnace at room temperature, the temperature raised to 475° C and maintained over night or to the formation of a white ash. On removal from the furnace, the samples were allowed to cool to room temperature, 0.2 ml of H_2PtCl_6 reagent was added to each tube and agitated to dissolve the ash. 5 ml of absolute ethyl alcohol, saturated with K_2PtCl_6 , was added to each tube and mixed well using fine glass rods. The stirring rods were rinsed into the tubes with 1 ml of alcohol, and the tubes allowed to stand at room temperature for 30 minutes. They were then sedimented by spinning for 5 minutes at 2000 RPM, the supernatant alcohol removed with

* Macalaster-Bicknell Company, No. C-1546, 1937 catalogue.

** Macalaster-Bicknell Company, No. C-1535, 1937 catalogue.

a capillary pipette, care being taken not to disturb the precipitate. The precipitates were washed by resuspension, by stirring, in 5 ml of fresh alcohol, the stirring rods rinsed with 1 ml of alcohol, and again spun down for 5 minutes at 2000 RPM.

After the second centrifugalization as much of the alcohol was removed as was possible without disturbing the precipitate. The tubes were then immersed in a water bath at 70° C and the temperature raised gradually to the boiling point and maintained there until the precipitates were dry and free from alcohol. The precipitates were dissolved in 5 ml of water (at 80° C with agitation), 1 ml of 2 N KI added to each, and maintained at 80° C for 3 to 5 minutes to favor complete conversion of the chloroplatinate to iodoplatinate. The tubes were then cooled to room temperature and titrated with standard $\text{Na}_2\text{S}_2\text{O}_3$ to a clear yellow color, free from traces of red.

Calculations:

$\text{ml of Na}_2\text{S}_2\text{O}_3 \times \text{normality} \times 1000 = \text{milliequivalents per liter}$

$\text{milliequivalents per liter} \times 3.91 = \text{mg K per 100 ml of serum.}$

Tubes showing a precipitate of platinum on their walls during titration were discarded as not having been adequately freed from alcohol. Duplicate samples showing variations over 2 per cent were checked by analysis of a third sample, and when the amount of serum sufficed by a second pair of duplicates.

EXPERIMENTAL RESULTS

Table I summarizes the histories, cutaneous reactions, and treatment of the patients in this series and gives the detailed results of the potassium analyses in each case.

Table II shows the distribution of the potassium values for the entire series, as well as the distributions when the series is broken into groups on both chronological and symptomatic bases. These distributions are indicated graphically in Figure I. The statistical details of the series are given in connection with the individual groupings of the data. The mean of the serum-potassium values for the entire series of allergic patients is 5.23 milliequivalents per liter (20.42 mg per 100 ml), with a median of 5.12 meq/L (20.0 mg/100 ml) and a modal range of 4.99 to 5.22 meq/L (19.5 to 20.4 mg/100 ml), containing 21 per cent of all cases.

A series of ten normal controls is summarized in Table III, and also graphically in Figure II. The mean level of serum-potassium for the series of controls is 4.66 meq/L (18.21 mg/100 ml).

TABLE 1

Patient	Age, Sex	Symptoms	Date of Onset	Positive Cutaneous Reactions	Treatment in 1940	Level of serum potassium			Symptoms	COMMENT
						mg per liter	meq per liter	meq per 100 ml		
FA	43 M	HF	8/39	Rgwd	Rgwd, pressas	8/15/40	6.00	23.4	0	Complete relief. No reactions.
MA	30 F	HF	8/35	Rgwd Feath	Rgwd, peren	8/8/40 9/12/40	4.82 4.85	18.1 19.0	0 0	Almost complete relief Sneezing following injections.
LA	33 F	HF	8/33	Rgwd	Rgwd, pressas	8/8/40 9/5/40	5.55 4.71	20.9 18.4	0 +	Almost complete relief Slight sneezing in AM during Rgwd season.
DA	55 M	HF	7/33	Rgwd Tim	Rgwd, pressas Tim, "	8/15/40 8/22/40 9/5/40 9/12/40	4.24 4.84 4.75 5.10	16.6 18.1 18.6 19.9	0 + ++ +	Fair relief. Symptoms from Aug 15 to Sept 8 1940. Pt has hypertension.
OB	44 F	HF As	8/27	Rgwd Dogs	Rgwd, peren Dust, "	8/12/40	6.44	25.2	0	Almost complete relief
BB	17 F	HF	6/36	Sir Tim Rgwd Dust	Rgwd, peren Tim, pressas	8/5/40 8/26/40	5.37 5.45	21.0 21.3	0 +	Fair results. Slight HF 5/25 to 6/8/40 and 8/25 to 9/28/40.
JB	9 M	HF	6/40	Tim Rgwd Dust	Rgwd, pressas	8/8/40	4.98	19.6	0	Complete relief.
PC	15 M	HF	7/38	Tim Rgwd Wool Feath	Rgwd, pressas Tim, "	8/22/40	4.25	18.6	++	Complete relief except for HF++ between 8/20 and 8/31/40.
GEC	32 M	HF As	5/23 10/35	Sir Tim Rgwd Dust	Rgwd, peren Tim, " Sir, "	8/24/40	5.93	23.2	+	Slight HF 2 wks in May 1940. Complete relief June and July. HF+ and slight asthma 6/15 to 8/15/40.
TC	M	HF	5/37	Tim Rgwd Dogs	Rgwd, pressas	8/8/40 8/26/40	5.08 4.79	19.9 18.7	0 +	Almost complete relief.
EE	22 F	HF As	9/35 6/38	Tim Rgwd Altern	Rgwd, pressas Tim, "	8/15/40 9/12/40	4.90 4.46	19.2 17.5	0 0	Fairly good results. As + on 9/11/40.
MAF	F	HF	8/34	Tim Rgwd Dust Wheat	Rgwd, peren	8/12/40	5.48	21.4	+	About 75 per cent relief
GF	38 F	Cough	6/33	Tim Rgwd	Rgwd, pressas Tim, "	8/22/40	5.09	19.9	+	Fairly good results, but not entirely free from symptoms.
EG	26 F	HF	5/35	Sir Tim Rgwd	Rgwd, pressas Tim, " Sir, "	8/15/40 9/12/40	5.09 4.59	19.9 17.9	0 0	Complete relief in Rgwd season. Some symptoms in Sir and Tim seasons.
VG	44 F	HF	8/32	Rgwd	Rgwd, pressas	8/19/40	5.72	22.4	0	Almost complete relief
RJ	24 F	HF	9/37	Rgwd Altern	Totantil 3 tid	9/5/40 9/12/40	4.78 4.85	18.7 19.0	++ +	Fair relief, not symptom free. First sample taken before treatment.
AK	61 M	HF	8/19	Rgwd Wheat	None	9/5/40	5.82	22.8	++	Wheat acts as inhalant excitant; Pt was a baker
OK	43 F	Cough As	1923	Tim Rgwd Dust Feath	Rgwd, pressas Tim, " Dust, peren	8/22/40	5.02	19.6	+	Fair relief; Not symptom free.
RL	16 M	HF	8/32	Tim Rgwd	Rgwd, pressas	8/5/40 9/5/40	4.91 5.13	19.2 20.1	0 +	Fairly good results. Very slight HF.
AL	33 F	HF	1925	Tim Rgwd Dust	None	8/22/40	4.72	18.5	+	
FM	45 F	HF	8/36	Tim Rgwd	Rgwd, peren	8/12/40	5.76	22.5	+	Good results though not symptom free. Experienced 1 constitutional reaction.
AMed	15 F	HF As	8/36	Rgwd Dust Feath	Rgwd, peren	8/5/40	4.80	18.8	+	Fair results.
MMed	51 F	HF	8/26	Sir Rgwd Tim	Rgwd, pressas Sir, " Tim, "	8/5/40 9/5/40	5.05 4.62	19.7 18.1	0 +	Good results in Sir season. Fair results in Rgwd season. Slight symptoms 8/12 to Sept.
AM	35 F	HF As	6/23	Rgwd	Rgwd, pressas	8/26/40	5.13	24.0	+	Fairly good results. Sample taken during mild asthmatic attack.
JOC	17 M	As	9/33	Tim Rgwd	Rgwd, peren Tim, "	8/15/40	5.74	22.4	0	Complete relief.
RO	50 M	HF	8/27	Rgwd	Rgwd, pressas	8/15/40	4.72	18.5	0	Complete relief.
RP	17 M	HF As	1920	Sir Tim Rgwd	Rgwd, peren Sir and Tim in 1939.	8/19/40 9/5/40	5.65 5.62	22.1 21.6	+	Good results but not completely symptom free.
HP	16 M	HF Eot	1930	Poplar Tim Rgwd	Rgwd, pressas	8/5/40	5.30	21.4	0	Almost complete relief.
MR	19 M	HF	9/29	Tim Rgwd	Rgwd, peren	8/8/40 9/5/40	5.40 5.77	21.1 22.6	0 +	Fairly good results, not symptom free.
SR	F	HF	5/26	Sir Tim Rgwd	Rgwd, pressas Tim, " Sir, "	8/8/40	5.47	21.4	+	Fair results. Symptoms persisted, though milder in intensity.
VS	38 F	HF	5/39	Oak Tim Rgwd Dust	Rgwd, pressas Tim, " Sir, "	8/5/40	5.40	21.1	0	Almost complete relief. 2 days of slight HF in entire season.
MCS	40 F	HF	8/34	Rgwd Altern Dust Feath	Rgwd, pressas Altern, "	8/12/40 9/5/40	5.34 5.03	20.9 19.6	+	Fairly good results. Asthma is becoming an occasional symptom.
RHS	12 M	HF As Infant	1937	Sir Tim Rgwd Dust Feath	Rgwd, peren	8/26/40	5.94	23.2	0	Complete relief. This Pt also shows + reactions to various foods and animal danders.
MS	30 F	HF	8/30	Tim Rgwd	Rgwd, pressas	8/12/40 9/5/40	5.12 5.06	20.9 19.3	0 +	Very good results. 3 days of HF in season. Pt trimmed lawn on worst of these days.
JS	27 F	HF	8/38	Dust	Rgwd, pressas Tim, "	8/15/40 9/5/40	5.04 5.23	19.7 20.4	+	Very good results, but not symptom free. Diag of Rgwd and Tim sensitivity based on incidence of sympt. Cutaneous reactions negative.
GMT	32 M	ehr head cold	8/34	Sir Tim Rgwd Dust Feath	Rgwd, pressas Tim, " Tim, "	8/12/40 9/5/40	4.72 4.29	18.5 16.8	0 +	Good results but not entirely symptom free.
EAT	15 F	HF	8/39	Rgwd	Totantil 2 tid	9/12/40	5.49	21.5	++	Sample taken before treatment started.
AW	25 F	HF	8/39	Sir Rgwd	None	9/5/40	5.59	21.9	++	
LN	20 F	HF	5/38	Oak Sir Tim Rgwd Dust Feath	Rgwd, pressas Tim, pressas	8/12/40	5.35	20.9	0	Complete relief in Rgwd season. 7 days of HF in Tim season. Pt observed dust precautions and eliminated feathers.
EW	40 F	HF	7/20	Rgwd Feath? Wheat?	Rgwd, peren	8/19/40	5.15	24.0	+	Ocular symptoms 8/8 to 9/10/40. Had complete relief in 1935, 36, 37, 38. Almost complete relief 1939. Has sharp limit of tolerance at 0.10 ml Rgwd 0.1. Experienced constitutional reactions in 1936, 37, 38 (1 severe)
RW	34 F	HF	8/34	Tim Rgwd	Rgwd, pressas	8/12/40 8/26/40	5.35 5.87	20.9 23.0	+	Slight symptoms in last weeks of June. HF+ 8/7 to 9/16/40.
RW	F	HF	6/37	Rgwd	None	8/15/40	5.28	20.6	+	Mild HF through out Rgwd season.
Total 42 patients.						Total 61 determinations.				

TABLE II

Distribution of Entire Series.

Total	-	61 determinations.				16.5-17.4	3
						17.5-18.4	6
Mean value	-	20.42 mg/100 ml	5.23 meq/liter			18.5-19.4	11
St. Dev.	-	1.92 "	0.491 "			19.5-20.4	13
						20.5-21.4	12
Median	-	20.0 "	5.12 "			21.5-22.4	6
Q ₁	-	18.8 "	4.81 "			22.5-23.4	7
Q ₃	-	21.6 "	5.53 "			23.5-24.4	2
Q ₁ - Q ₃ Interval	-	2.8 "	0.716 "			24.5-25.4	<u>1</u>
MODE	-	19.5 to 20.4 mg/100 ml					<u>61</u>

Division of Series into Those before August 15, 1940 and Those after.

		Before		After		Before		After	
		mg/100 ml	meq/L	mg/100 ml	meq/L				
Mean	-	20.56	5.26	20.34	5.20	0	16.5-17.4	3	
S:D.	-	1.52	0.389	2.08	0.813	1	17.5-18.4	5	
						3	18.5-19.4	8	
						4	19.5-20.4	9	
Median	-	20.9	5.35	19.9	5.09	10	20.5-21.4	2	
Q ₁	-	19.5	4.99	18.6	4.76	0	21.5-22.4	6	
Q ₃	-	21.3	5.45	22.3	5.71	1	22.5-23.4	6	
Q ₁ - Q ₃	-	1.8	0.460	3.7	0.946	0	23.5-24.4	2	
						<u>1</u>	24.5-25.4	<u>0</u>	
Total	-	20		41		<u>20</u>		<u>41</u>	

Division of Series into Those with Symptoms and Those without.

		With		Without		With		Without	
		mg/100 ml	meq/L	mg/100 ml	meq/L				
Mean	-	20.40	5.22	20.29	5.19	2	16.5-17.4	1	
S.D.	-	1.93	0.494	1.93	0.494	3	17.5-18.4	3	
						6	18.5-19.4	5	
						7	19.5-20.4	6	
Median	-	20.1	5.14	19.9	5.09	6	20.5-21.4	6	
Q ₁	-	18.7	4.78	19.0	4.86	3	21.5-22.4	3	
Q ₃	-	21.9	5.60	21.4	5.47	5	22.5-23.4	2	
Q ₁ - Q ₃	-	3.2	0.819	2.4	0.614	2	23.5-24.4	0	
						<u>0</u>	24.5-25.4	<u>1</u>	
Total	-	34		27		<u>34</u>		<u>27</u>	

Patients with Both Hay Fever and Asthma.

Mean	-	21.76 mg/100 ml	5.563 meq/L	17.5-18.4	1
S.D.	-	2.31 "	0.591 "	18.5-19.4	1
				19.5-20.4	1
Median	-	22.3 "	5.70 "	20.5-21.4	0
Q ₁	-	19.6 "	5.02 "	21.5-22.4	3
Q ₃	-	23.2 "	5.94 "	22.5-23.4	2
Q ₁ - Q ₃	-	3.6 "	0.92 "	23.5-24.4	1
				24.5-25.4	<u>1</u>
Total	-	10			<u>10</u>

FIGURE I

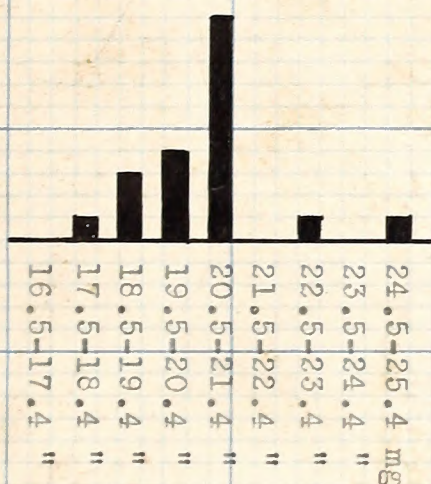
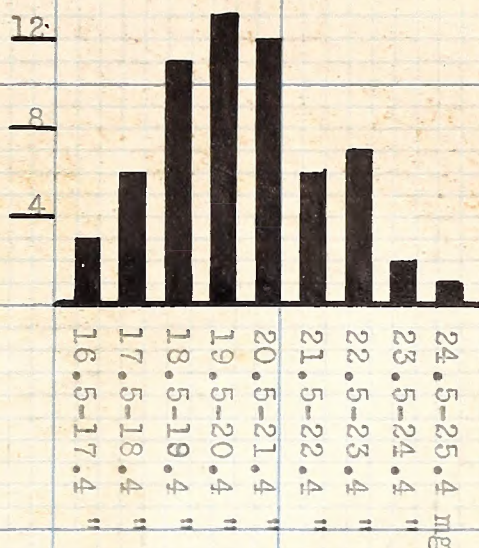
Complete series.

61 cases.

Mean - 5.23 meq/L

St. Dev. - 0.491 "

Coef. of Disp. - 9.40 per cent

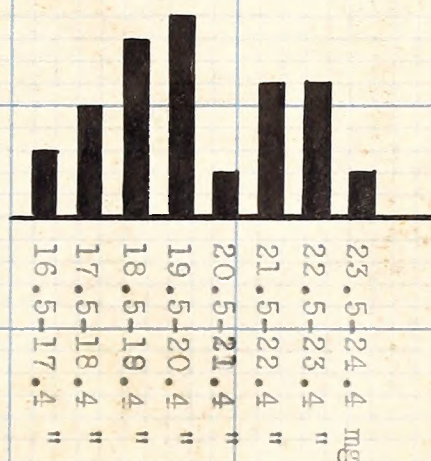


Before 8/15/40 Total - 20

Mean - 5.26 meq/L

S.D. - 0.389 "

Disp. Coef. - 7.40 per cent

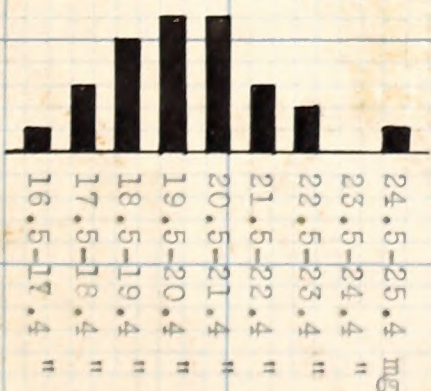


After 8/15/40 Total - 41

Mean - 5.20 meq/L

S.D. - 0.813 "

Disp. Coef. - 10.2 per cent

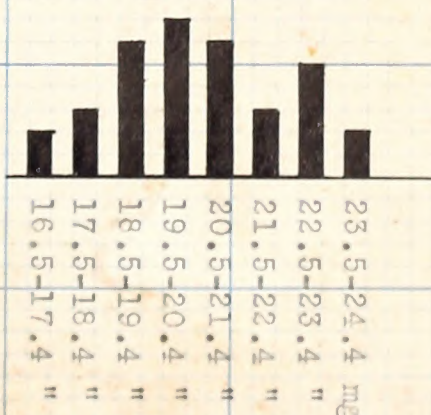


Without sympt. Total - 27

Mean - 5.19 meq/L

S.D. - 0.494 "

Disp. Coef. - 9.50 per cent



With sympt. Total - 34

Mean - 5.22 meq/L

S.D. - 0.494 "

Disp. Coef. - 9.46 per cent

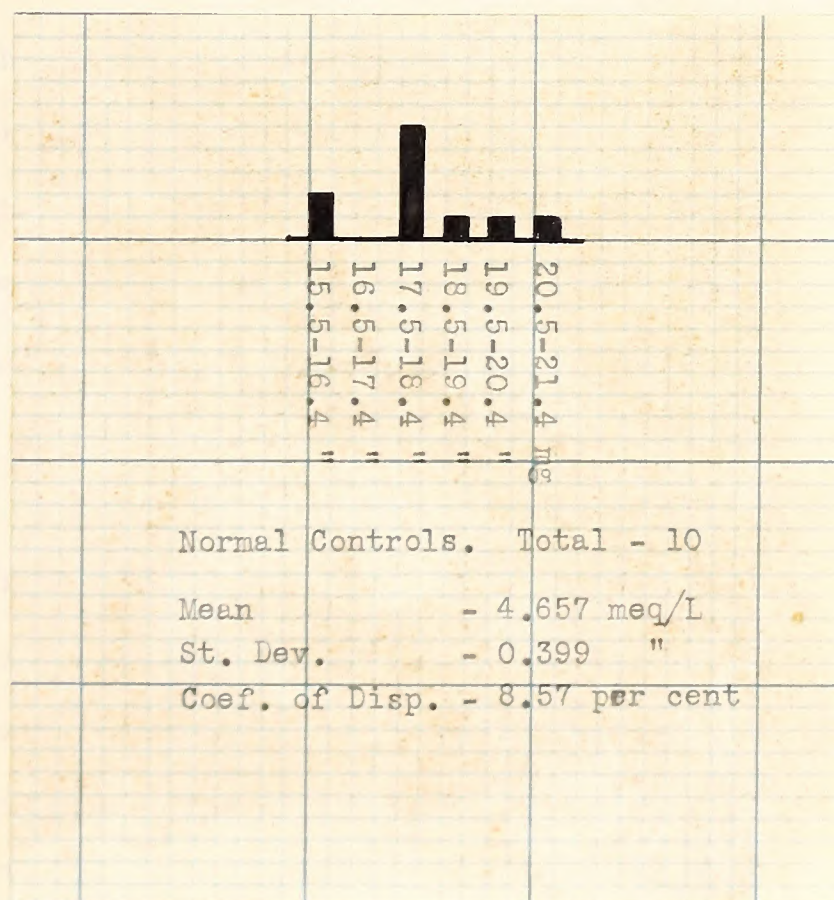
TABLE III

Normal Control Series.

Total -- 10 determinations.

Mean value	--	18.21 mg/100 ml	4.657 meq/liter	15.5-16.4	2
St. Dev.	--	1.56 "	0.399 "	16.5-17.4	0
				17.5-18.4	5
Median	--	17.9 "	4.52 "	18.5-19.4	1
Q ₁	--	17.5 "	4.48 "	19.5-20.4	1
Q ₃	--	19.2 "	4.92 "	20.5-21.4	1
Q ₁ - Q ₃ INTERVAL	--	1.7 "	0.44 "		<u>10</u>
Coef. of Dispers	--	8.57%			

FIGURE II



DISCUSSION

The potassium levels found in the ten controls are in close agreement with the normal values reported by other workers. (12, 38, 41, 51, 54, 65, 70, 77, 80, 88, 94, 105, 110, 120, 121, 123) Despite the range of 0.134 meq/L (5.3 mg/100 ml) between the extremities of this series the values are grouped rather compactly about the median value of 4.52 meq/L (17.9 mg/100 ml). This is indicated by the $Q_1 - Q_3$ interval of only 0.44 meq/L (1.7 mg/100 ml) and the fact that the modal interval, 4.48-4.71 meq/L (17.5-18.4 mg/100 ml) contains half the cases of the entire series. The formal measure of this tendency, the coefficient of dispersion, has a value of 8.57 per cent.

Although the mean value for the series of allergic patients is somewhat higher than that for the controls, the difference is not striking. The difference between the two series is more in the dispersion of the values through the entire range than in the absolute levels. The $Q_1 - Q_3$ interval for the series of patients with hay fever is 0.716 meq/L (2.8 mg per 100 ml), half the values falling between 4.81 and 5.53 meq/L (18.8 and 21.6 mg/100 ml), and the modal level of 4.99 to 5.22 meq/L (19.5 to 20.4 mg/100 ml) contains but twenty one per cent of all cases, showing a wider dispersion from the median than in the normal series. The coefficient of dispersion for this series has a value of 9.4 per cent. This increase in "scatteration" is even more evident if we consider the chronologically divided series.

The group of samples taken before August 15, 1940 shows a median of 5.35 meq/L (20.9 mg/100 ml); Q_1 of 4.99 meq/L (19.5 mg/100 ml); and Q_3 of 5.45 meq/L (21.3 mg/100 ml), corresponding to a $Q_1 - Q_3$ interval

of 0.460 meq/L (1.8 mg/100 ml), and has a coefficient of dispersion of 7.40 per cent. Those taken after August 15, 1940 show a median of 5.09 meq/L (19.9 mg/100 ml), Q_1 of 4.76 meq/L (18.6 mg/100 ml), and Q_3 of 5.71 meq/L (22.3 mg/100 ml) with a $Q_1 - Q_3$ interval of 0.946 meq/L (3.7 mg/100 ml) and a coefficient of dispersion of 10.2 per cent. Although the median value for the first group is somewhat higher than that for the normals the grouping of the series about the median is remarkably similar. On the other hand the second group shows twice the spread for the $Q_1 - Q_3$ interval and an appreciably higher coefficient of dispersion as compared either with the normals or with the analyses done previous to August fifteenth. The same tendency toward greater scatter of the serum-potassium values is seen in the series that have been segregated according to the presence or absence of symptoms, although not to as marked a degree. The $Q_1 - Q_3$ intervals in the asymptomatic and the symptomatic series are 0.614 meq/L (2.4 mg/100 ml) and 0.819 meq/L (3.2 mg/100 ml) respectively, and the coefficient of dispersion is practically identical for both, 9.50 and 9.46 per cent respectively.

Nine of the patients in the series suffered from asthma as well as from hay fever. The ten analyses done on blood from these patients, taken as a separate group, show a median level of 5.70 meq/L (22.3 mg/100 ml), and a coefficient of dispersion of 10.6 per cent. Thus this group shows the highest level of serum-potassium and also the greatest degree of scatter of the individual values.

In comparing the various subgroups of the series it is seen that the median potassium levels show a progressive increase from 4.52 meq/L for the normals to 5.70 meq/L for those patients with both hay fever and asthma. The values for the asthmatics agree in general with

those reported in the literature. (46, 51, 80, 83, 88, 118) Exact comparisons are difficult because of the influence of the patient's condition at the time of bleeding on the level of the serum-potassium concentration. Many of the reported values are for patients during asthmatic seizures, whereas in this series one patient exhibited mild wheezing and the remaining eight were free from asthma at the time the blood samples were obtained.

The median values for the series of patients with hay fever agree well with the two series reported in the literature. (46, 80) The elevations in median potassium levels above that of the controls found for the hay fever and asthma patients (0.782 meq/L and 1.564 meq/L respectively) are not striking, although they probably represent significant changes. The gradation of the degree of dispersion of the individual levels through the three groups parallels the increase in median levels, 8.57, 9.50 and 10.6 per cent for the normals, hay fever sufferers, and asthmatic patients respectively. Whether or not other workers have observed this increased spread of serum-potassium values cannot be ascertained inasmuch as none has analyzed his data with reference to this statistical property. In this series the change in the distribution of the serum-potassium values has appeared more striking than the actual variation of the serum-potassium levels proper.

The similarity in nature of the data of the normal series and of the series taken before August fifteenth is not amazing when one recalls that in every case represented by the latter group symptoms had not yet appeared, and that during this period the group represented essentially normal individuals. One might expect the group of asymptomatic

patients to show similar findings, regardless of the time of sampling. However, it is possible that continued contact with the offending pollen would cause some alteration of the potassium metabolism despite the absence of clinical symptoms, and result in the type of distribution observed for this series. Although the asymptomatic group includes all cases in the first chronological group, the transfer of ten cases from the later time group could have altered the character of the newly formed series purely as a consequence of the method of sampling. At any rate, whatever the explanation, the two groups that were segregated according to the presence or absence of symptoms show no significant difference either in the mean potassium level or in the degree of dispersion of the individual values.

One might similarly attribute the highest degree of dispersion of serum-potassium values found in the series of asthmatic patients to the more profound effect on mineral and water metabolism associated even with mild asthmatic attacks. The rapid and profound changes in potassium, sodium, and water balances occasioned by precipitation of and recovery from asthmatic seizures lends credence to this view.

The more general assumption that the allergic individual possesses an inherently unstable mechanism for the control of potassium metabolism, and that the extent and severity of symptoms is a reflection of the degree of that instability is a tempting explanation for the variations seen in this series. However it fails to explain the essentially normal pattern of the series of preseasonal determinations found in this study. Moreover, the present paucity of data upon which such a generalization would of necessity be founded stamps it immediately as apochryphal in origin and hardly satisfactory as a tenable working hypothesis.

SUMMARY

The serum-potassium levels have been determined in a series of forty-one patients suffering from ragweed hay fever.

The median value for the series is 5.23 milliequivalents per liter (20.42 milligrams per 100 milliliters).

The series is characterized more by a greater dispersion of values of serum-potassium than by any marked increase in values over those of normal individuals. This tendency toward individual fluctuations is more marked during the ragweed-pollinating season than before the onset of pollination.

It is possible that this fluctuation represents a relative instability of the mechanism of potassium regulation in the allergic individual as compared to that of the normal. It may also be a manifestation of a reaction to contact with the atopic excitant although clinical symptoms may not occur.

BIBLIOGRAPHY:

1. Abt, A. F.: Note on oral administration of potassium chloride in the treatment of hay fever, nasal allergy, asthma and sinusitis. *Am. J. Med. Sci.* 198, 229, 1939.
2. Association of Official Agricultural Chemists, Official and Tentative Methods of --; Washington, 4th edition, pg 12, 1935.
3. Baldassi, G.: Quantitative Determination of Potassium in Horse Serum by Modification of Kramer-Tisdall Technique. *Diag. e tec. di lab.* 6, 948, 1935.
4. Basnuevo, J. G. and Anido, V.: Determinacion Cuantitativa del Potasio en la Sangre. *Rev. de med. trop. y parasitol., bacteriol., clin. y lab.* 3, 453, 1937.
5. Beckman, H.: Allergy and the Acid-Base Balance. *J.A.M.A.* 95, 1582, 1930.
6. Bisgard, J.D., McIntyre, A.R., and Osheroff, W.: Studies of Sodium, Potassium, and Chlorides of Blood Serum in Experimental Traumatic Shock, Shock of Induced Hyperpyrexia, High Intestinal Obstruction, and Duodenal Fistulas. *Surgery* 4, 528, 1938.
7. Bloom, B.: The Use of Potassium Salts in Hay Fever: Preliminary Report. *J.A.M.A.* 111, 2281, 1938.
8. Bloom, B. and Grauman, S.J.: Potassium in Allergy. *Southwestern Med.* 23, 205, 1939.
9. Blum, L., Aubel, E. and Hausknecht, R.: Les variations de la teneur du sang et des humeurs en sodium et en potassium après ingestion des sels de sodium et de potassium. *Compt. rend. Soc. de biol.* 85, 498, 1921.
10. Breh, F. and Gaebler, O.H.: Determination of Potassium in Blood Serum. *J. Biol. Chem.* 87, 81, 1930.
11. Brewer, G.: The Relation of Plasma Potassium Level to Metabolic Activity. *Am. J. Physiol.* 129, 345, 1940.
12. Briggs, A.P.: A Study of the Inorganic Elements of Blood Plasma. *J. Biol. Chem.* 57, 351, 1923.
13. Brock, N., Druckrey, H. and Herkey, H.: Significance of Potassium for Living Tissues. *Biochem. Z.* 302, 393, 1939.
14. Bullock, B., and Kirk, P.I.: Volumetric Microdetermination of Chloride and Potassium Ions. Application of the Potassium Method to Sea Water. *Ind. and Eng. Chem. (Anal. Ed.)* 7, 178, 1935.

15. Caltabiano, D.: Use of Cerium Salts in Determination of Calcium, Potassium and Chloride. *Diag. e tec. di lab.* 6, 865, 1935.
16. Cameron, F.K. and Failyer, G.H.: The Dtermination of Small Amounts of Potassium in Aqueous Solutions. *J. Am. Chem. Soc.* 25, 1063, 1903.
17. Camp, W.J.R. and Higgins, J.A.: The Role of Potassium in Epinephrine Action. *J. Pharm. Exp. Therap.* 56, 376, 1936.
18. Cicardo, V.H. and Moglia, J.A.: Liberation of Potassium from Muscle by Acetylcholine. *Nature* 145, 551, 1940.
19. Clausen, S.W.: A Method for the Estimation of Potassium in Blood. *J. Biol. Chem.* 36, 479, 1918.
20. Cohen, A.E.: The Treatment of Chronic Urticaria with High Protein, Low Sodium, Acid-Ash Diet, with Added Potassium Chloride. *J. Allergy* 10, 61, 1938.
21. Consolazio, W.V. and Talbott, J.H.: Modification of the Method of Shohl and Bennett for the Determination of Potassium in Serum and Urine. *J. Biol. Chem.* 126, 55, 1938.
22. Conway, E.J. and Boyle, P.J.: A Mechanism for the Concentratine of Potassium by Cells, with Experimental Verification for Muscle. *Nature* 144, 709, 1939.
23. Cook, M.M. and Stoesser, A.V.: Influence of Induced Variations in Electrolyte and Water Exchanges with Pitressin in Bronchial Asthma. *Proc. Soc. Exp. Biol. and Med.* 38, 636, 1938.
24. Crabtree, M.G. and Maizels, M.: Potassium Content and Cell Volume of Centrifuged Erythrocytes. *Biochem. J.* 32, 74, 1938.
25. Cumings, J.N.: Estimation of Potassium, and Potassium Content of Normal Muscle. *Biochem. J.* 33, 642, 1939.
26. Curatolo, A.: Adrenalin and Blood Potassium. *Biochim. terap. sper.* 24, 423, 1937.
27. DeGowin, E.L., Harris, J.E. and Ploss, E.D.: Studies on Preserved Blood. *J. A. M. A.* 114, 855, 1940.
28. Denes, S.: Iodometric Microdetermination of Potassium in Serum. *Microchemie* 26, 277, 1939.
29. Downman, C.B.B., Oliver, J.O. and Young, I.M.: Partition of Potassium in Stored Blood. *Brit. Med. J.* I, 559, 1940.
30. Drew, C.R., Edsall, K. and Scudder, J.: Studies in Blood Preservation. Fate of Cellular Elements in Relation to Potassium Diffusion. *J. Lab. and Clin. Med.* 25, 240, 1939.

31. Druckrey, H., Herken, H., and Brock, N.: The Significance of Potassium for Live Tissues. *Naturwissenschaften* 27, 418, 1939
32. D'Silva, J.L.: Action of Adrenalin on Serum Potassium. *J. Physiol.* 86, 219, 1936.
33. Duffendack, O.S., Thomson, K.B., Lee, W.C., and Koppins, O.G.: Method for Quantitative Spectrochemical Analysis of Very Small Amounts of Biological Materials for Sodium, Potassium, Calcium, Magnesium and Lead. *J. Biol. Chem.* 126, 1, 1938.
34. Duliere, W.L.: Données experimentales sur la répartition du potassium dans le sang extravasé; comparaison entre la concentration physiologique dans le plasma et la concentration dans le liquide céphalorachidien. *Compt. rend. Soc. de biol.* 108, 416, 1931.
35. Durupt, A., and Schlesinger, A.: Microdosage colorimétrique du potassium dans le sang. *Bull. Soc. chim. biol.* 13, 700, 1931.
36. Dworzak, R. and Ballozo, H.: Determination of Potassium with the Magnesium Salt of Dipicrylamine (Hexanitrodiphenylamine). Microchemical determination of Potassium and the Separation of Potassium and Sodium. *Microchemie* 26, 322, 1939.
37. Engelsher, D.L.: Potassium Chloride in Allergy. *J. A. M. A.* 113, 961, 1939.
38. Erickson, B.N., Williams, H.H., Hummel, F.C., and Macy, I.G.: The Lipid and Mineral Distribution in the Serum and Erythrocytes of Normal Children. *J. Biol. Chem.* 118, 15, 1937.
39. Feldberg, W., and Guimaraes, J.A.: Liberation of Acetylcholine by Potassium. *J. Physiol.* 86, 306, 1936.
40. Fiske, C.H. and Litarczek, G.: A New Method for Potassium. *J. Biol. Chem.* 67, 689, 1926. (Proceedings)
41. Furey, E.D.: Normal Variations in Proteins and Inorganic Elements of the Blood Serum. *Proc. Staff Meetings Mayo Clinic* 13, 730, 1938
42. Furstenberg, F.F. and Gay, L.N.: Observations on the Ineffectiveness of Oral Administration of Potassium Chloride in Various Forms of Allergy. *Bull. Johns Hopkins Hosp.* 67, 219, 1940.
43. Hahn, L.A., Hevesy, C., and Rebbe, O.H.: Do the potassium ions inside the muscle cells and blood corpuscles exchange with those present in the plasma? *Biochem. J.* 33, 1549, 1939.
44. Harley, D.: Note on Oral Potassium Chloride Therapy in Asthma, Hay Fever, Urticaria and Eczema. *J. Allergy* 11, 38, 1939.

45. Harrison, H.E. and Darrow, D.C.: Volumetric Method for Determination of Potassium in Biological Materials. J. Biol. Chem. 121, 631, 1937.
46. Harsh, G.F. and Donovan, P.B.: Potassium Chloride in Allergic Disorders. J. A. M. A. 114, 1859, 1940.
47. Hartzler, E.R.: Note on the Determination of Potassium by the Method of Shohl and Bennett. J. Biol. Chem. 122, 19, 1937.
48. Heiduschka, A. and Ober, H.: Photometrische Methode zur Bestimmung des Kaliumgehalts im Blute. Biochem. Ztschr. 292, 191, 1937.
49. Hodgman, C.D. and Lange, N.A.: Handbook of Chemistry and Physics. Chemical Rubber Publishing Co., Cleveland, Ohio. 16th edition. 1931.
50. Hoffman, W.S.: Photoelectric Determination of Potassium in Minute Quantities of Serum. J. Biol. Chem. 120, 57, 1937.
51. Hoffman, W.S. and Jacobs, H.R.D.: The Partition of Potassium between the Serum and Corpuscles in Health and Disease. J. Lab. and Clin. Med. 19, 633, 1934.
52. Hubbard, R.S.: Note on the Precipitation of Small Amounts of Potassium as Potassium Sodium Cobaltinitrite. J. Biol. Chem. 100, 557, 1933.
53. Hubbard, R.S. and Garbutt, H.R.: A Modification of the Kramer and Tisdall Method for Detecting Potassium in Serum. J. Clin. Path., Tech. Suppl. 9, 119, 1939.
54. Jacobs, H.R.D. and Hoffman, W.S.: A New Colorimetric Method for the Estimation of Potassium. J. Biol. Chem. 93, 685, 1931.
55. Jeanneney, G. and Servantie, L.: Determination of Potassium as a Test for Alteration in Stored Blood. Compt. rend. Soc. biol. 129, 1189, 1938.
56. Jeanneney, G., Servantie, L. and Ringenbach, G.: Changes in the Potassium/Sodium Ratio of Plasma in Citrated Blood Stored in the Refrigerator. Compt. rend. Soc. biol. 130, 472, 1939.
57. Kawe, A.: Sensitivity of de Koninck's Test for Potassium and the Magnitude of the K_2O Factor in the Microchemical Determination of Potassium by the Method of Kramer and Tisdall. Z. anal. Chem. 115, 385, 1939.
58. Kaye, I.A.: Determination of Minute Amounts of Potassium; Iodometric Evaluation of the Cobaltinitrite Precipitate with Ceric Sulfate. Ind. Eng. Chem., Anal. Ed. 12, 310, 1940.

59. Kerr, S.E.: Studies on the Inorganic Composition of the Blood. I-
The Effect of Hemorrhage on the Inorganic Composition of Serum
and Corpuscle. J. Biol. Chem. 67, 689, 1926.
60. Kertscher, F.: Experiments with the Siemens Apparatus for the Flame
Photometric Determination of Potassium in Neubauer Seedling
Ashes. Bodenkunde u. Pflanzenernahr. 9-10, 758, 1938.
61. Keys, A.: The Response of the Plasma Potassium Level in Man to the
Administration of Epinephrine. Am. J. Physiol. 121, 325, 1938.
62. Kolthoff, I.M. and Bendix, G.H.: Determination of Potassium with
Hexanitrodiphenylamine (Dipicrylamine) Reagent. Ind. Eng. Chem.
Anal. Ed. 11, 94, 1939.
63. Kramer, B.: Direct Quantitative Determination of Potassium and
Sodium in Small Quantities of Blood. J. Biol. Chem. 41, 263,
1920.
64. Kramer, B. and Gittleman, .: Gasometric Determination of Potassium
Proc. Soc. Exp. Biol. and Med. 24, 241, 1926.
65. Kramer, B. and Tisdall, F.F.: A Clinical Method for Quantitative
Determination of Potassium in Small Amounts of Serum. J. Biol.
Chem. 46, 339, 1921.
66. Kramer, B. and Tisdall, F.F.: The Direct Quantitative Determination
of Sodium, Potassium, Calcium and Magnesium in Small Amounts of
Blood. J. Biol. Chem. 48, 223, 1921.
67. Kramer, B. and Tisdall, F.F.: The Distribution of Sodium, Potassium
Calcium and Magnesium Between the Corpuscles and Serum of Human
Blood. J. Biol. Chem. 53, 241, 1922.
68. Kuschinsky, G.: Über das Verhalten von Kalium und Calcium im Blut
des Hundes beim Histaminschock. Ztschr. f. d. ges. exper. Med.
64, 563, 1928.
69. Lebermann, F.: Eine einfache klinische Methode zur Bestimmung
kleiner Kaliummengen im Blutserum und anderen Flüssigkeiten.
Biochem. Z. 150, 548, 1924.
70. MacCallum, A.B.:
Tr. Coll. of Physicians 39, 286, 1917.
71. Marenzi, A.D. y Gerschmann, R.: Sobre la Determinacion del Potasio
en Sangre. Un Methode Modificado para su Determinacion.
Rev. soc. Argentina biol. 8, 38, 1932.

72. Marenzi, A.D. and Gerschmann, R.: The Photometric Determination of Potassium in Biological Fluids. *Anales farm. bioquim.* (Buenos Aires) 9, 85, 1938.
73. McGuigan, H.A. and Higgins, J.A.: Changes in the Circulatory Effect of Potassium Salts Due to Epinephrine. *Am. J. Physiol.* 114, 207, 1935.
74. Michaelis, L. and Yamaguchi, S.: Oxidation-Reduction Systems of Biological Significance. V- The Composition of the Oxidized Cobalt Complex of Cysteine. A Colorimetric Method for the Micro Analysis of Cobalt. *J. Biol. Chem.* 83, 367, 1929.
75. Moglia, J.L.: Variations in Plasma Potassium in States of Hypotension and Hypertension. *Anales farm. bioquim.* (Buenos Aires) 10, 26, 1939.
76. Moglia, J.L.: Action of Adrenalin on Plasma Potassium. *Rev. soc. Argentina biol.* 15, 5, 1939.
77. Myers, V.C. and Short, J.J.: The Potassium Content of Normal and Some Pathological Human Bloods. *J. Biol. Chem.* 48, 83, 1921.
78. Nathan, E. and Stern, F.: Uber Kalium- und Calciumschwankungen im Blutserum bei Dermatosen. *Arch. f. Dermat. u. Syph.* 156, 446, 1928.
79. Norinder, E.: Quantitative spektralanalytische Bestimmungen von Calcium, Kalium, Natrium und Magnesium in Kleinen Blutserum-mengen. *Biochem. Z.* 299, 168, 1938.
80. Parker, F.P.: Blood Potassium Studies in Allergic States: Relation to Potassium Therapy. *Southern Med. J.* 33, 1301, 1940.
81. Peters, J.P. and Van Slyke, D.D.: Quantitative Clinical Chemistry. Williams and Wilkins Co., Baltimore, Maryland. Vol. 2, pg 746, 1932.
82. Peterson, H.: Volumetrische Bestimmung des Goldes und Platins. *Z. anorg. Chem.* 19, 59, 1899.
83. Rapport, .: In discussion of paper of Wenner and Buhrmester, *J. Allergy* 9, 85, 1938.
84. Rehberg, P.B.: A Method of Microtitration. *Biochem J.* 19, 270, 1925.
85. Robinson, R.J. and Putnam, G.L.: The Determination of Small Amounts of Potassium by Means of Silver Cobaltinitrite. *Ind. Eng. Chem., Anal. Ed.* 8, 211, 1936.

86. Rubin, S.S., Aaronson, A.L., Kaplan, M.A., and Feinberg, S.M.: Potassium Salts in the Treatment of Pollinosis. A Clinical Evaluation. J. A. M. A. 114, 2359, 1940.
87. Rusk, H.A. and Kenamore, B.D.: Urticaria -- A New Therapeutic Approach. Ann. Int. Med. 11, 1838, 1938.
88. Rusk, H.A., Weichselbaum, T.E. and Somogyi, M.: Changes in Serum Potassium in Certain Allergic States. J. A. M. A. 112, 2395, 1939.
89. Salit, P.W.: A Microcolorimetric Method for the Determination of Potassium in Biological Materials. J. Biol. Chem. 136, 191, 1940.
90. Schittenhelm, A., Erhardt, W., u. Warnat, K.: Über den Kalium- und Calciumgehalt von Blut und Organen des Kaninchen und des Hundes und seine Veränderungen beim Sensibilisierten und Anaphylactischen Tier. Anaphylaxiestudien bei Mensch und Tier. VII Mitteilung. Ztschr. f. d. ges. exper. Med. 58, 662, 1928.
91. Schmitt, L. and Breitweiser, W.: The Applicability of Various Apparatus to the Flame Photometric Determination of Potassium in the Ash of Neubauer Seedlings. Bodenkunde u. Pflanzenernähr. 9-10, 750, 1938.
92. Schubert, M.P.: Cobalt Complexes of Cysteine. J. Am. Chem. Soc. 53, 3851, 1931.
93. Schweartz, H.: Einwirkung des Adrenalins auf den Kaliumgehalt des Blutserums. Arch. Exp. Path. u. Pharmacol. 177, 628, 1935.
94. Scudder, J., Corcoran, D.R. and Drew, C.R.: Blood Preservation. The Serum Potassium of Cadaver Blood. Surg. Gynecol. Obstet. 70, 48, 1940.
95. Scudder, J., Drew, C.R., Corcoran, D.R. and Bull, D.C.: Studies in Blood Preservation. J. A. M. A. 112, 2263, 1939.
96. Scudder, J., Zwemer, R. L. and Whipple, A.O.: Acute Intestinal Obstruction. Ann. Surg. 107, 161, 1938.
97. Shemtsis, O.G.: Microvolumetric Determination of Potassium. J. Applied Chem. (U.S.S.R.) 11, 1012, 1938.
98. Shohl, A.T. and Bennett, H.B.: A Micro Method for the Determination of Potassium as Iodoplatinate. J. Biol. Chem. 78, 643, 1928.
99. Smith, F. and Steffenson, W.H.: Potassium Chloride in Allergy. J. Michigan Med. Soc. 39, 485, 1940.

100. Sobel, A.E. and Kramer, B.: A New Colorimetric Method for the Quantitative Estimation of Small Amounts of Potassium. *J. Biol. Chem.* 100, 561, 1933.
101. Stoesser, A.V. and Cook, M.M.: Possible Relation between Electrolyte Balance and Bronchial Asthma. *Am. J. Dis. Child.* 56, 943, 1938.
102. Stoesser, A.V. and Cook, M.M.: Electrolyte and Water Exchange in Bronchial Asthma, with Emphasis on the Influence of Pitressin. *J. Allergy* 11, 557, 1940.
103. Takahashi, H.: (In Japanese) *Tohoku Igaku-Zasshi* 7, 27, 1923.
104. Talbott, J.H. and Brown, M.R.: Ménière's Syndrome -- Acid-Base Constituents of the Blood: Treatment with Potassium Chloride. *J. A. M. A.* 114, 125, 1940.
105. Talbott, J.H. and Schwab, R.S.: Recent Advances in the Biochemistry and Therapeutics of Potassium Salts. *N. E. J. M.* 222, 585, 1940.
106. Tarusov, B.N. and Burlakova, E.V.: The Condition of Potassium within the Erythrocytes. *Bull. biol. méd. exptl. (U.S.S.R.)* 7, 400, 1939. (In English)
107. Taylor, F.H.L.: The Determination of Potassium in Blood Serum. *J. Biol. Chem.* 87, 27, 1930.
108. Tenery, R.M. and Anderson, C.E.: A Photoelectric Method for the Microdetermination of Potassium in Blood Plasma by the Chloroplatinate Precipitation. *J. Biol. Chem.* 135, 659, 1940.
109. Thaler, J.L.: Evidence of Permeability of Tissue Cells to Potassium. *Proc. Soc. Exper. Biol. and Med.* 33, 368, 1935.
110. Thelen, H.: Calcium, Potassium and Sodium Content of Plasma, Serum and Erythrocytes. *Ztschr. f. Physiol. Chem.* 250, 221, 1937.
112. Thomson, K.E. and Lee, W.C.: Application of Spectrographic Analysis to Quantitative Determination of Sodium, Potassium, and Magnesium in Biological Fluids. *J. Biol. Chem.* 118, 711, 1937.
113. Tisdall, F.F. and Kramer, B.: Methods for the Direct Quantitative Determination of Sodium, Potassium, Calcium and Magnesium in Urine and Stools. *J. Biol. Chem.* 48, 1, 1921.
114. Treadwell, F.P. and Hall, W.T.: *Analytical Chemistry. Vol. II Quantitative Analysis.* John Wiley and Sons., 1915.
115. Truszkowski, R. and Zwemer, R.L.: Cortico-Adrenal Insufficiency and Potassium Metabolism. *Biochem. J.* 30, 1345, 1936.

116. Truszkowski, R. and Zwemer, R.L.: Determination of Blood Potassium. *Biochem. J.* 31, 229, 1937.
117. Truszkowski, R. and Zwemer, R. L.L. Experimental Alterations in Blood Potassium. *Acta biol. exper.* 12, 112, 1938.
118. Vallogini, G.: Variations of Potassium and Calcium during Asthmatic Attacks and Experimental Anaphylactic Shock. *Fisiol. e med.* 7, 803, 1936.
119. Volhard, J.: Ueber eine neue Methode der massanalytischen Bestimmung des Silbers. *Jour. f. prakt. Chem.* 9, 217, 1874.
120. Waelsch, H.: Die wahren Serumwerte und die Absterbeerscheinungen des Blutes. *Med. Klin.* Nr. 14, 451, 1935.
121. Waelsch, H., Kittel, S. u. Busztin, A.: Die Bewegung der Mineralstoffe zwischen Blutkörperchen und Plasma und die Grundformen der Permeation. *Ztschr. Physiol. Chem.* 234, 27, 1935.
122. Webster, R.W. and Brennan, W.A.: Potassium and Tartrates. The Commonwealth Press, Chicago, 1927.
123. Weichselbaum, T.E., Somogyi, M. and Rusk, H.A.: A Method for the Determination of Small Amounts of Potassium. *J. Biol. Chem.* 132, 343, 1940.
124. Wenner, W.F. and Buhrmester, C.C.: Potassium and Acetylcholine of the Blood of Rabbits in Anaphylactic Shock. *J. Allergy* 9, 85, 1937.
125. Yoshimatsu, S.: A Colorimetric Method for Determination of Potassium with 0.2 cc of Blood. *Tohoku J. Exp. Med.* 8, 174, 1926.
126. Yoshimatsu, S. and Uga, Y.: A Modification of Yoshimatsu's Potassium Method with 0.1 cc of Blood. *Tohoku J. Exp. Med.* 19, 156, 1932
127. Zwemer, R.L. and Scudder, J.: Potassium Changes in Experimental Shock. *Am. J. Physiol.* 119, 427, 1937. (Proceedings)
128. Zwemer, R.L. and Scudder, J.: Blood Potassium during Shock. *Surgery* 4, 510, 1938.
129. Zwemer, R.L. and Truszkowski, R.: The Importance of Corticoadrenal Regulation of Potassium Metabolism. *Endocrinology* 21, 40, 1937

CONCENTRATIONS OF POTASSIUM IN THE
SERUM OF SELECTED PATIENTS
WITH HAY FEVER

Abstract of a Dissertation

Submitted in partial fulfilment of the requirements for the degree of
Doctor of Philosophy

BOSTON UNIVERSITY GRADUATE SCHOOL

By

MATTHEW ARNOLD DEROW

S.B., College of the City of New York, 1929

A.M., Columbia University, 1930

M.D., Boston University, 1934

Department: Medical Sciences

Field of Specialization: Biochemistry

Major Instructor: Professor Burnham S. Walker

1941

Studies in experimental animals and in human beings indicate a marked derangement of the potassium balance during shock. The plasmapotassium content is found to increase when shock is produced by whatever means such as trauma, hemorrhage, visceral manipulation, drugs, or anaphylactic reactions. This increase in extracellular potassium has its origin in the diffusion of potassium ions from the cells. Moreover, excessive concentrations of potassium ions are injurious to cells and will thereby cause a further depletion of cellular potassium.

The roles of potassium in metabolism seem to be:

- 1/ The chief intracellular base, playing the part within the cell that sodium does in the extracellular fluids;
- 2/ The maintenance of muscular tone by its balance against the effects of sodium and calcium ions;
- 3/ Antagonist to insulin and cholinesterase, and as an epinephrine-like substance.

The depletion of intracellular potassium following injury or excessive stimulation of cells makes further stimulation ineffective. However, if the medium surrounding the depleted cell contains available potassium ions, diffusion of this potassium back into the cell results in a recovery of the cell's ability to respond normally to new stimuli.

On the basis of the relation of potassium to epinephrine and histamine reactions Rusk and Kenamore suggested the use of potassium salts in the treatment of urticaria. Their "New Approach" consisted in the use of a high protein, low sodium, acid-ash diet, with the addition of potassium chloride. In 1938 Bloom reported successful palliative treatment of hay fever sufferers by the application of this "New Approach" of Rusk and Kenamore. Various other workers followed this original report with both corroborations and refutations of Bloom's claims.

In no case had any of the investigators studied the variations if any, of the serum-potassium content of hay fever patients with reference to incidence of symptoms or type of treatment employed. Because of this dearth of data in regard to patients with hay fever it was deemed advisable to study a series of such people from the point of view of possible variations of the potassium level.

The subjects in this series are for the great majority patients at the Allergy Clinic of the Massachusetts Memorial Hospitals. To have comparable conditions, as far as possible, in the individual cases of the series, the study was limited to uncomplicated cases of ragweed hay fever. In this way one could time fairly definitely the onset of exposure to the allergic excitant by checking with the advent of the ragweed pollinating season.

The analytical procedure employed is the chloroplatinate micro-method of Consolazio and Talbott. This method was chosen because of its combination of a high degree of precision with a minimal amount of intricate manipulative detail. All analyses were performed in duplicate and occasionally in triplicate or quadruplicate.

The median level of potassium for the entire series of forty-one patients is 5.23 milliequivalents per liter (20.42 milligrams per 100 milliliters) of serum. Although this represents only a slight increase over the median for a group of normal controls, statistical analysis of the data shows a definite divergence from normal in the distribution of individual values through the series. Thus the allergic individuals show a greater dispersion of the values of serum-potassium content than that of the normal series, as shown by the greater extent of the $Q_1 - Q_3$ interval and by the higher value of the coefficient of dispersion. This tendency toward individual fluctuations is more marked during the ragweed-pollinating season than before the onset of pollination.

It is suggested that this fluctuation may represent a relative instability of the mechanism of regulation of potassium balance in the allergic individual as compared to that of the normal. It may also be a manifestation of a subclinical reaction to contact with the atopic excitant.

Additional copies may be obtained on application to

DEAN HOWARD M. LESOURD

Boston University Graduate School

Boston, Massachusetts

AUTOBIOGRAPHY

Born: April 29, 1909 in New York, New York.

Parents: Dr. David Derow
Mrs. Ida Derow

Primary education: New York public schools, graduated in 1922.

Secondary education: Townsend Harris Hall High School, New York, 1925.

Colleges attended: College of the City of New York, B. S. 1929.
Columbia University, A. M. 1930.
Boston University School of Medicine, M. D. 1934

Positions held: Teaching fellow in Biochemistry, Boston University
School of Medicine, 1936 to 1938.
Assistant in Bacteriology and Immunology, Boston University
School of Medicine, 1937 to 1939.
Instructor in Bacteriology and Immunology, 1939 ---
Instructor in Clinical Laboratory Technic, Boston University
College of Practical Arts and Letters, 1938 ---

Chemist and Bacteriologist, Town of Natick, Mass., 1935 ---
Visiting Physician, Allergy Clinic, Massachusetts Memorial
Hospitals, 1936 ---
Pathologist, Norfolk County Hospital, South Braintree, Mass
1938 ---

Scientific and Professional Affiliations:

Massachusetts Medical Society.
American Medical Association.
American Association for the Advancement of Science.
Society of American Bacteriologists.
New York Academy of Sciences.
Boston Microchemical Society.
Boston Allergy Round Table.

PHOTOGRAPH of CANDIDATE



BOSTON UNIVERSITY



1 1719 02487 7724

